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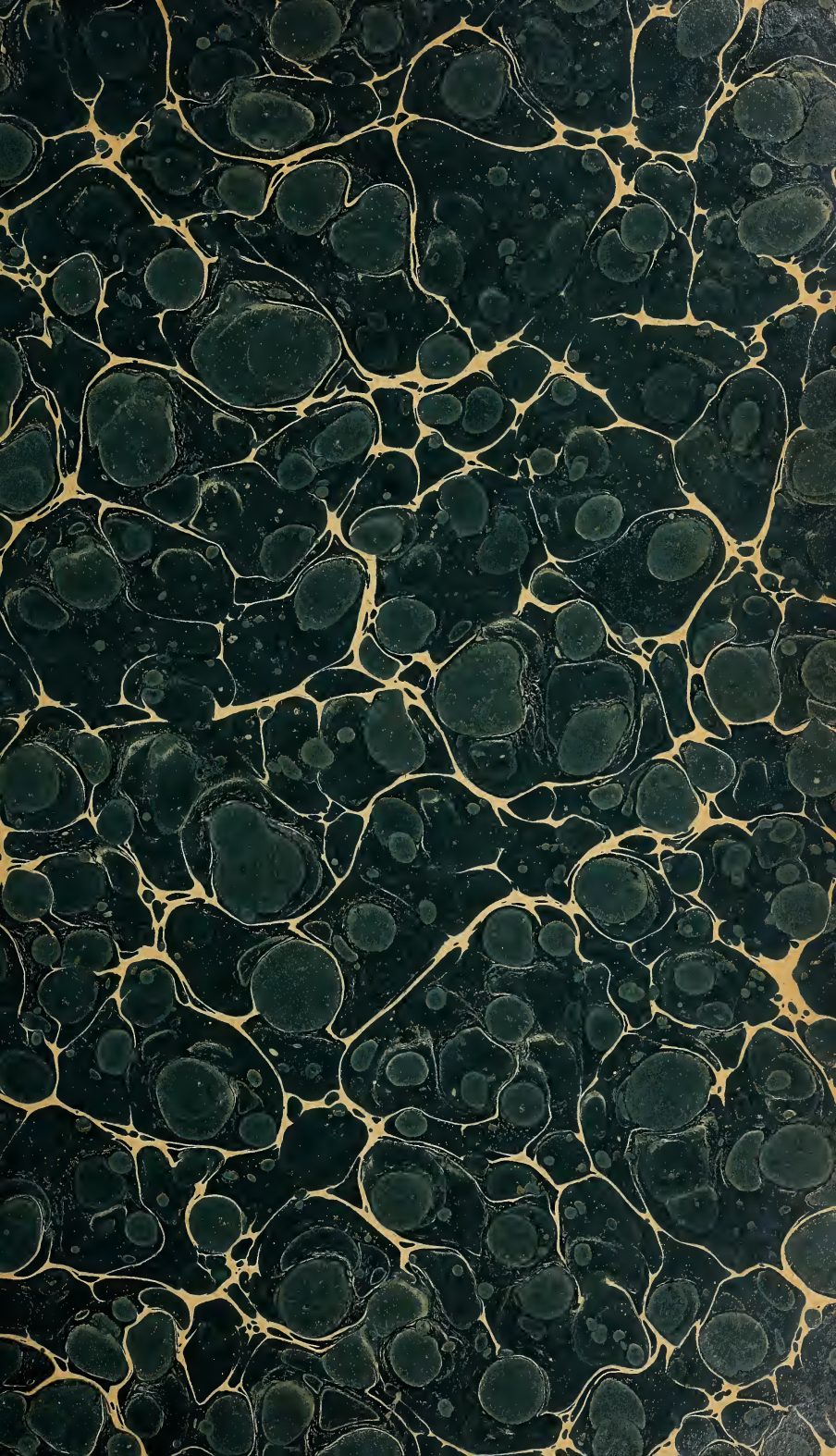
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United States Department of Agriculture

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist.

THE IMPORTED CABBAGE WORM.

(Pontia rapæ Linn.)

By F. H. CHITTENDEN,

In Charge of Breeding Experiments.

GENERAL CHARACTERISTICS.

The worst of the many destructive enemies of cabbage and other crucifers is the larva or caterpillar of a white butterfly known to science as *Pontia (Pieris) rapæ* Linn. The caterpillar, called the imported cabbage worm, is altogether too well known by farmers throughout this country as well as in the Old World, and the adult in sect, the imported cabbage butterfly, called also the white or rape butterfly, is a familiar object to nearly everyone. It is generally recognized that the butterfly is the parent of the "worms."

This cabbage worm is velvety green in color, much like the cabbage on which it feeds; and the surface of the body, if viewed through an or-

inary hand lens, is seen to be somewhat rough and finely dotted with small black spots. There is a faint yellow stripe down the middle of the back and a row of yellow spots along each side in line with the spiracles or breathing pores. It measures, when full-grown, about an inch and a fourth, presenting the appearance shown in figure 1, *c*.

The butterfly has a wing expanse of nearly two inches, and is white, marked with black near the tips of the fore-wings, as shown at figure 1, *a*, representing the female. In this sex there are two conspicuous black spots on each fore-wing; the male (fig. 2) has only one. Both

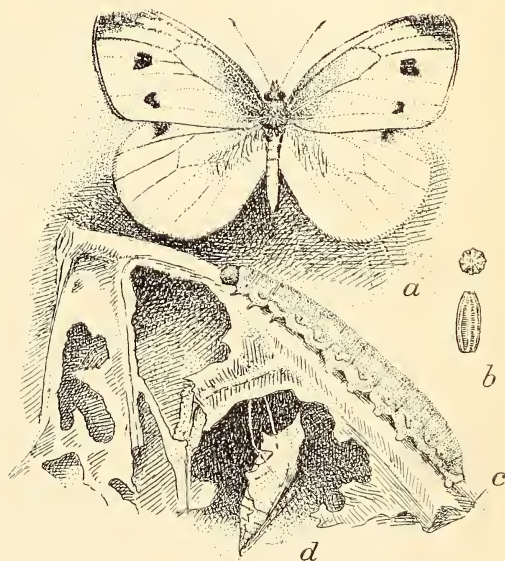


FIG. 1.—*Pontia rapæ*: *a*, female butterfly; *b*, above, egg as seen from above; below, egg as seen from side; *c*, larva in natural position on cabbage leaf; *d*, suspended chrysalis—*a*, *c*, *d*, slightly enlarged; *b*, more enlarged (original).

sexes have a corresponding smaller black spot at the upper extremity of the hind-wings. The body of the female is whitish; that of the male is usually darker above. The male is generally a little the smaller. The under surface of the hind-wings are uniform satiny straw-yellow and there are generally two black spots showing through, in both sexes.

The eggs are fusiform, pale yellowish, and strongly ribbed (fig. 1, *b*). They are large enough to be readily seen with the unaided eye, and are deposited singly, usually on the lower surface of the outer leaves of cabbage and other food plants.

When the caterpillar or "worm" becomes full grown it attaches itself to a cabbage leaf or other nearby object, fastens itself by means of a string-like girdle, and often within the same day transforms to a chrysa-

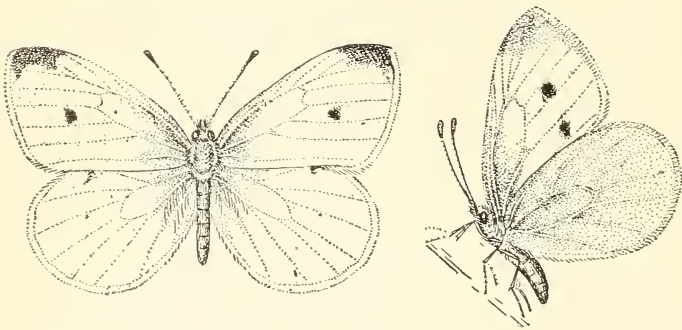


FIG. 2.—Imported cabbage butterfly: male, wings expanded, at left; wings folded in natural resting position at right—somewhat enlarged (original).

lis of the appearance indicated at figure 1, *d*. The chrysalis is of variable color, seeming to be influenced in this respect by the object upon which it is placed. The color thus varies from dirty gray to yellow, green, and dark gray. The length of the chrysalis is a little less than three-fourths of an inch.

NATURE OF INJURY.

This cabbage worm has been rightly termed the bane of the cabbage-grower, and the dread of every careful cook and housewife. It begins work early in the season, and the principal damage is therefore usually to young plants. After riddling the outer leaves, which continue afterward attached to the stalk, it attacks the more tender inner leaves as they form, frequently secreting itself in the heads, which are made most unsightly by its dark green excrement, and where it is difficult to reach with insecticides. As a result, cabbages before being sent to market must be carefully examined and the damaged leaves plucked away; and before cooking it is frequently necessary to tear the heads apart to see that no disgusting "worm" is lurking within. Even after the dish is cooked there is danger of an admixture of animal with the vegetable food. In cool weather the caterpillar frequently feeds in free exposure on the upper surface of the leaves in the sunshine.

As early as 1869, when this cabbage worm was restricted to limited areas in Canada, New England, and New York, it did great damage. At St. Albans Bay, Vt., in that year it caused the total destruction of a crop of 3,000 cabbage plants. The worms made their appearance about the first of September, and there were from 10 to 50 on a head. The Abbé Provancher estimated the same year a loss of \$240,000 in the vicinity of Quebec alone. One farmer near Montreal lost in a single season over 12,000 heads of cabbage. The following year, according to Mr. Angus, the entire crop of cabbage and cauliflower in some places about New York City, where the insects had appeared only the year before, was destroyed. The loss was estimated at half a million dollars.

An interesting feature connected with the establishment of this insect in America is the practical extirpation, at least as a pest, of the so-called southern cabbage butterfly (*Pontia protodice* Boisd.¹) in many regions. This is accounted for in part by the earlier spring appearance of the imported species, enabling the caterpillars to obtain possession of the best feeding places and crowd out the less hardy native form.²

ORIGIN AND DISTRIBUTION.

The imported cabbage butterfly was introduced from Europe perhaps half a century before the date of present writing,³ and was first recognized from a capture at Quebec, Canada, in 1860. It was not again seen until two years later, in the same locality. For several years after this it was observed at intervals in other portions of Canada. In 1865 its first appearance in the United States was noticed in Maine. The following year it was seen in northern New Hampshire and Vermont. By 1868 it had reached New York, and a few years later began to attract attention, as each year thereafter it was found in some new locality. In 1875 it appeared in Cleveland, Ohio, and two years later in Illinois. By 1880 it had penetrated southward to the Gulf region. This distribution has continued until now the species is known practically in every State and Territory of the Union, although it is occasionally reported as new to some more or less isolated locality.

It does not appear to be an inhabitant of any particular life zone, seeming to be as much of a pest in the Gulf States as in Canada and New England.

In the Eastern Hemisphere this butterfly ranges from the Atlantic to

¹ This native species and the imported cabbage butterfly are very generally referred to in literature as *Pieris protodice* and *P. rapae* respectively.

² It is well known that nearly all species introduced from the Eastern Hemisphere are more hardy than native American forms and survive conditions which would be unfavorable to the latter. In the writer's experience, the southern cabbage butterfly is more susceptible to disease than the imported species. Occasionally the latter returns in moderate numbers to localities from which it has apparently been absent for long periods.

³ Riley believed it was introduced in 1856 or 1857 (see Rept. Dept. Agr. for 1883, p. 108). A monographic account of this species is given by Scudder (Butterflies Eastern U. S. and Can., Vol. II, pp. 1171-1190, 1205-1218).

the Pacific, in most localities between the thirtieth and sixtieth degrees of latitude. In Switzerland it occurs on the level of perpetual snow, and in this country it has been taken on the barren subalpine heights of the White Mountains.

FOOD AND OTHER HABITS.

The imported cabbage worm feeds on the foliage of nearly all cruciferous plants, is particularly fond of cabbage and cauliflower, and somewhat less destructive to turnip, radish, mustard, and horseradish. It also does considerable injury to ornamental plants, such as nasturtium, mignonette, sweet alyssum, and spider plant (*Cleome*).¹

The butterflies sip the nectar of flowers of many kinds, and are to be seen any time hovering over them. They are especially fond of the white blossoms of crucifers, also of such plants as white aster, lavender, and thistle. Like other butterflies, this species is diurnal, and is on the wing from early morning until near dusk. It is a comparatively slow flyer, but capable of extended flight for long distances. The butterflies sometimes congregate in immense swarms, as has frequently occurred where the insect has emigrated from the continent of Europe to England. Its occurrence in mid-ocean has been recorded.

LIFE HISTORY.

The butterflies appear as early as March, even in the Northern States, and thereafter can usually be seen flying about cabbage fields and elsewhere, throughout the year, until after several severe frosts in October. In the Gulf States they occur throughout the season.

Egg deposit commences soon after the butterflies appear; in fact, pairing and egg-laying may begin within a day or two after the adult issues from the chrysalis. The duration of the different stages varies according to temperature. The observed egg period is from four to eight days.

The larva eats voraciously and grows with great rapidity, attaining full maturity in from ten days to two week after hatching. It molts four times; hence there are five distinct stages, the first molt taking place (in warm weather) in about two days from the hour of hatching, the second stage lasting two or three days; the third and fourth, one or two days each, and the fifth, four or five days². The duration of the chrysalis stage is from seven days to a fortnight during the summer time, but the last chrysalides formed in the more northern States remain undeveloped during the winter until the following spring.

The life cycle occupies periods varying between twenty-two days and five weeks. Even in New England this species is credited with being triple-brooded, but in the District of Columbia and vicinity there

¹ It is a decided pest on this plant in the District of Columbia.

² Technical descriptions of the different larval stages with particular reference to wing development are given by W. F. Mercer (*Jour. N. Y. Ent. Soc.*, Vol. VIII, pp. 1-20, March, 1900).

must be one or more additional generations, and there is a possibility of at least six in the extreme South. The first generation develops on wild plants.

NATURAL ENEMIES.

Were it not for certain natural checks this species would be a still greater pest than it is. The most important of its insect enemies are small parasites, all introductions from Europe. One of them, a Bra-

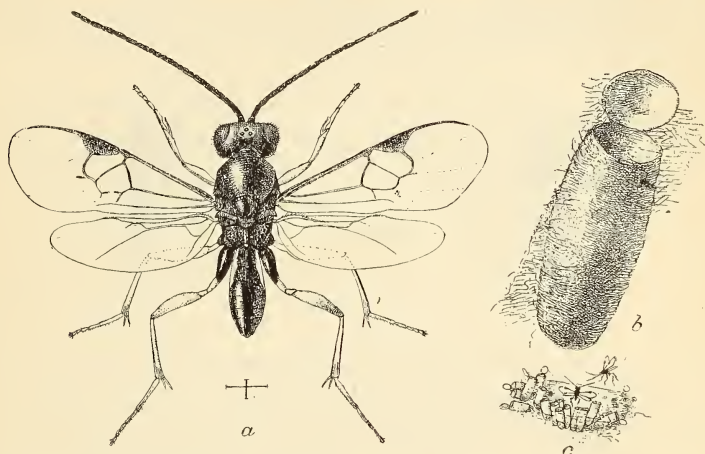


FIG. 3.—*Apanteles glomeratus*: a, adult fly; b, cocoon; c, flies escaping from cocoons—
a, b, highly magnified; c, natural size (original).

conid, *Apanteles glomeratus* Linn. (fig. 3), was purposely imported in 1883 from England. During the autumn of 1904 this species held its

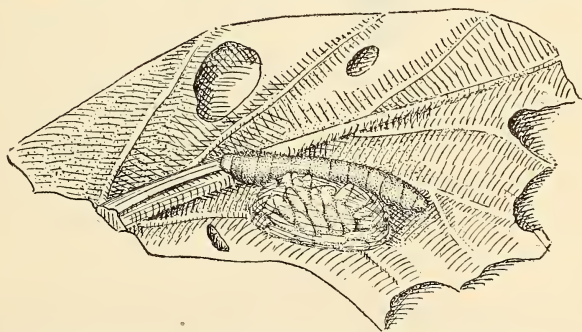


FIG. 4.—Parasitized cabbage worm (*Pontia rapae*), showing cocoon mass
of *Apanteles glomeratus* below (original).

host under complete control at Washington, D. C., killing every "worm" which came under the writer's observation. A larva which has been destroyed by this parasite is shown in figure 4, together with the parasite's cocoons. A secondary parasite, a minute chalcis fly, *Tetrastichus microgastri* Bouché, was also present, but did not militate against the effectiveness of the *Apanteles*. Of similar importance to

this *Apanteles* is a chalcis fly, *Pteromalus puparum* Linn. (fig. 5), noticed in this country in 1869, having evidently been imported with its host.

Wasps, particularly *Polistes pallipes* Lepel., and related forms are also of great service in reducing the numbers of this and other cabbage worms, appearing to prefer them to other prey.

A small, evil-smelling plant-bug, *Phymata wolfii* Stål. (fig. 6), secretes itself in flowers, such as thistle and goldenrod, and destroys numbers of the butterflies, capturing them and sucking out their vital fluids.

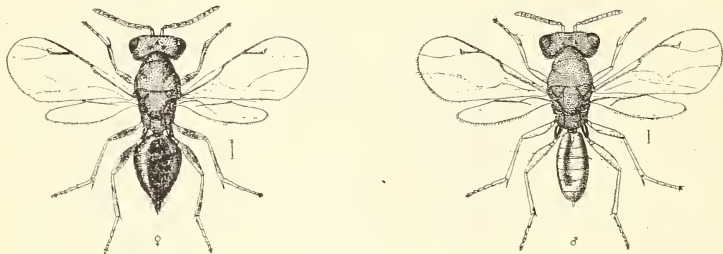


FIG. 5.—*Pteromalus puparum*: female at left; male at right—highly magnified (original).

Numerous other enemies attack this cabbage worm in addition to the ones that have been enumerated,¹ and it is sometimes subject to a contagious bacterial disease² similar to that of the cabbage looper.³



FIG. 6.—*Phymata wolfii*: a, dorsal view; b, lateral view; c, front leg; d, snout—*a, b*, enlarged; *c, d*, more enlarged (from Riley).

It is, however, less susceptible to this malady, and is seldom destroyed in any numbers by it. The parasitic flies can be encouraged by collecting the larvæ and chrysalides of the cabbage butterfly and placing them in barrels or boxes covered with coarse mosquito netting,

which will prevent the butterflies from escaping when they develop and permit the much smaller parasites to issue and continue their good work.

REMEDIES.

In the treatment of this species it should be kept in mind that other "worms" and other cabbage pests, are more often present than not.

Arsenicals.—The best remedy is one of the arsenicals; and Paris green and arsenate of lead are preferred to others in common use. If the former is used it may be applied either dry or wet, preferably, however,

¹ Among other predaceous enemies observed in this country are the wheel bug (*Arilus cristatus* Linn.) and the armed soldier bug (*Podisus spinosus* Dall.). The cabbage worm is also parasitized by the Tachina fly *Exorista vulgaris* Fall. The writer has a list of 10 additional European parasites.

²*Micrococcus pieridis* Burrill. ³*Autographa (Plusia) brassicæ* Riley.

as a spray, at the rate of about 1 pound of the poison to 150 gallons of water. It should be applied when the plants are first set out, so as to insure the poison reaching the young larvæ before they have burrowed far into the heads. Other applications should follow as required. These can be made with absolute safety until the heads are about half formed, and, for that matter, even later, as the poison disappears from plants almost completely within three or four weeks after application.¹

Bran mash.—A mixture of bran with Paris green, one of the standard remedies for cutworms as well as grasshoppers, is, according to the testimony of some who have used it, successful against “cabbage worms,” and should be tried against the present species. Any arsenical can be employed in the preparation of this mixture. It is best to mix the bran with water and sugar before adding the poison. The proportions are 2 or 3 ounces of sugar or other sweetening, and about 1 pound of bran, to a gallon of water; so as to make, when stirred, a mixture that will easily run through the fingers. In its application it is merely sprinkled, either wet or dry, over the affected plants.

The hot-water remedy.—As long ago as 1883 water, at a temperature of about 130° F., was advised as a remedy for this cabbage “worm.” It does practically no harm to the plants and kills all insects with which it comes in contact. It is scarcely applicable to large fields, however, on account of the difficulty of maintaining the proper temperature.

Kerosene emulsion is not as effective as the arsenicals, because in its application it is necessary for the spray to come into direct contact with the larvæ in order to kill them.

Pyrethrum is not so useful as an arsenical. Of its effectiveness Dr. James Fletcher, who still advocates its use in Canada, wrote in 1891 that “diluted with four times its weight of common flour, and then kept tightly closed for twenty-four hours (before use), leaves nothing to be desired, and thousands of dollars are yearly saved to small growers, who most need assistance.” Pyrethrum is rather costly and, though said to discolor the leaves, has the advantage of not being poisonous to human

¹ *Harmlessness of arsenicals when properly applied.*—Chemical analysis has shown that cabbage which has been dusted or sprayed with an arsenical in the way prescribed, and then prepared for cooking in the usual manner a week later, has not even a trace of arsenic remaining. The use of arsenicals against cabbage worms is almost universal in the United States, although growers are sometimes loath to acknowledge the fact for fear of the loss of customers who are not fully acquainted with the harmlessness of the remedy. There are no authentic recorded instances known to the writer of poisoning from the consumption of cabbage treated with an arsenical. According to Gillette, 28 cabbage heads, dusted in the ordinary way, would have to be eaten by a human being at one meal in order to produce poisonous effects. Still it is preferable, in order to avoid all danger, to use other insecticides in the case of vegetables that are to be eaten soon. On this head it might be well to cite the experience of a Virginia market gardener who dusted his cabbages with Paris green and flour, omitting to inform his family of the fact. A day or two later he ate heartily of this cabbage, as did others, and afterwards was questioned by his wife in regard to the peculiar powdery substance on the heads. Although poisoning was anticipated, no ill results followed.

beings or domestic animals. If it is not used in liberal quantity, however, a proportion of the caterpillars are merely numbed by this mixture and recover. Younger caterpillars are more susceptible.

Hand-picking.—For the kitchen garden where, for obvious reasons, it is undesirable to use arsenicals, hand-picking is sometimes practiced, especially when plants are first set out.

The corn-meal remedy.—According to Prof. L. Bruner, corn meal dusted on cabbage causes the “worms” to drop off, and protects the crop until the meal is washed away by rain. It is applied in the morning while the dew is on and is said to act as a deterrent.

Clean farming and trap crops.—If cooperation in clean methods of farming and in the use of arsenicals could by any possibility be secured, much of the loss due to the ravages of this pest might be averted. The practice of leaving cabbage stalks in the field after the main crop is off is a reprehensible one. All remnants should be gathered and destroyed with the exception of a few left at regular intervals through a field as lures for the females to deposit their eggs. Such stalks, being useless, should, where feasible, be freely poisoned with arsenicals so that the last generation will have no place to develop in the fields.

The utilization of natural enemies.—It is matter of common observation, frequently recorded, that the two parasitic enemies of this species (*Pteromalus puparum* and *Apanteles glomeratus*) do excellent service in reducing the numbers of their host. The means by which they can be encouraged is described on page 6.

Attempts have also been made to utilize diseases of this insect for its control, but without very encouraging results.

Hellebore will kill this “worm,” but is not as satisfactory a remedy as the arsenicals.

Trap leaves.—A remedy suggested by one of our correspondents was tested by the writer against this and other cabbage “worms,” including the looper, and found worthless. It consists in placing fresh cabbage leaves over the heads at night, the supposition being that the “worms” will gather under these traps and can be destroyed next morning.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., April 28, 1905.

